HOW TO PREPARE A NEPA AIR QUALITY ANALYSIS FOR PROJECTS INVOLVING PRESCRIBED FIRE

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This document was designed as a quick-start, how-to guide on preparing a NEPA air quality analysis for projects that include fire use and not as a comprehensive discussion of NEPA, fire use, or air quality. Suggested analyses by chapter of the NEPA document should be viewed as recommendations. The components of the analyis are what is important, general flow and layout are best determined at the local level. To increase usability, this guide has been kept as brief and to the point as possible. Further details on some topics are offered as appendices.

INTRODUCTION - AIR QUALITY AND NEPA ANALYSIS

Projects that involve the use of fire have the potential to impact air quality. Smoke from fires can impact human health, impair scenic vistas, create safety hazards, and/or cause a general nuisance. It is our responsibility to assess and disclose these impacts as part of NEPA, and to minimize any impacts to the extent possible. Knowledge needed for preparation of a NEPA air quality analysis for projects where fire will be used includes:

1. A basic understanding of air quality rules and regulations.
2. An understanding of uses, techniques, and behavior of prescribed fires.
3. Local knowledge of such things as location of sensitive areas, existing air quality, and meteorology.

The appropriate level of analysis for each project will vary with the size and complexity of the project. For example a small project with little burning in a remote area will likely have a brief analysis whereas a large, complex project that produces a lot of smoke in close proximity to a sensitive area will require a detailed analysis (see Attachment 1). Even in situations where no appreciable air quality impacts are expected, you should state in the document that potential air quality impacts were considered and were deemed minimal. Include a brief summary of the basis for this determination.

A more complex analysis of possible air quality impacts may be needed in a NEPA analysis if the project:

- Raised air quality as a significant issue in scoping,
- Includes a large amount of burning,
- May impact visibility in a Class I air shed,
- Is in close proximity to, or in, a non-attainment area,
- Is in close proximity to a sensitive area.

Information about the fire project may be included in a fuels specialists report and put in the project record. Important portions and results should be summarized and cited in the NEPA document. Be sure that enough information is revealed so the reader understands the results without having to search the record.

THE AIR QUALITY ANALYSIS

A. Purpose and Need/Proposed Action Section

Describe why fire use is necessary by comparing the existing condition with the desired condition. The difference is the "need for change". What management goals can be accomplished best with fire rather than some other treatment? This discussion should clarify for the reader concerned with air quality that fire was chosen only after other, less polluting methods were considered and ruled out since they would not accomplish the required objectives within other management contraints (such as cost).

B. Affected Environment Section

In this section, current air quality conditions are described along with environmental conditions that could influence the air quality impacts of the project. Areas of particular sensitivity to air pollution are identified. Even though this section is not required in an EA, enough information must be included in the document (purpose and need, alternatives, effects) so the reader understands the environment being affected. Summarize and cite the fuels report.

1. Describe the general meteorology of the project area. What are the prevailing wind patterns. Is the area prone to inversions? If so, when and at what elevation and how long do they typically last? The information provided should help the reader gage how quickly pollutants may disperse, whether they could accumulate, and where downwind they may go. General local knowledge and a qualitative description of typical meteorology during burning seasons is probably sufficient for many analyses. Greater detail can be added as needed by assessing typical conditions determined from web sites that summarize meteorological conditions such as Regional Climate Centers (http://www.wrcc.dri.edu/rcc.html), RAWS USA Climate Archive (http://www.raws.dri.edu/index.html), and VCIS at http://www.fs.fed.us/pnw/airfire/vcis/introduction.html

2. Identify sensitive areas that are downwind, or potentially downwind of the project location(s). Describe these downwind areas including: distance and direction from the project, why the area is considered sensitive, and when the area is considered sensitive. This information reveals the areas where we are most concerned with potential air quality impacts to human health, safety, nuisance, or visibility. Some potential sensitive areas include:
    - PM10, PM2.5, and ozone non-attainment areas. Two web pages that may be of use include one which provides simple access to basic maps of non-attainment areas: (http://www.epa.gov/oar/oaqps/greenbk/) And another that offers more options for generating customized maps but is less user friendly: (http://www.epa.gov/air/data/reports.html),
    - Class I areas (http://www2.nature.nps.gov/air/maps/images/ClassIAreas.jpg),
    - communities,
    - popular views or recreation areas,

- highways or airports,
- others (camps, nursing homes, hospitals, poultry farms, day care centers, etc.).

3. If the project is located within a nonattainment area you must determine whether the project is subject to General Conformity. If it is, then a General Conformity Determination must be completed prior to implementing the project. If needed, conduct conformity determination as part of the NEPA document rather than developing it separately before the implementation of the project since this will save time and expense.

4. Qualitatively describe existing air quality conditions in the areas surrounding the site. Does anything currently impact air quality (including visibility) in the sensitive areas? Is there a pattern to current air quality impacts? Are they seasonal? Duration of current air quality impacts should be described in hours, days, weeks, or months as appropriate. Use this discussion to describe other activities that go on in the area that may compound the air quality impacts from the project. This discussion characterizes other air quality considerations that may affect the timing and magnitude of the impacts from proposed burning. Other sources to consider include:

   - industry,
   - wood smoke (wood stoves, forest burning),
   - miscellaneous area sources (major roads, urban areas),
   - field burning,
   - wildfire.

The EPA AirData website (http://www.epa.gov/air/data/reports.html) mentioned previously allows users to generate reports or maps by county, state, or EPA region related to emissions produced by many of the sources listed above.

C. Issues and Alternatives Development

You may need to develop alternatives to your burning proposal if there are significant issues about burning or smoke. Depending on the Purpose and Need, you may develop in detail, or just consider and eliminate alternatives from detailed study. Alternatives could include less burning, a combination of burning and thinning, or just thinning, depending on the situation. The details are fully disclosed in the Alternative Description section.

Alternative Description

In this section, components of the Project and alternatives that will cause air pollution are identified and quantified. Possible mitigation measures are matched with pollution-emitting activities. If lengthy, details of these analyses may go in either the Project File or in an Appendix.

1. For each alternative, describe proposed burn units and fuels treatment options. Examine treatment options other than prescribed burning (for example, mechanical treatments). Document the treatment goal or, in other words, why fire is needed (hazard reduction, silviculture, ecosystem management, etc.).

2. Quantify the amounts and types of material to be burned by project alternative for all units where fire is planned. Set up a simple matrix describing each individual unit's

target season for burning, fuel arrangement, acreage, and smoke mitigation measures or BACM (best available control measures) that can be applied.

D. Environmental Consequences or Direct, Indirect, and Cummulative Effects

The Environmental Consequences section contains an analysis of how the alternatives will affect air quality within the project area and beyond, and when combined with other pollution sources. A summary of the results including enough information for full disclosure and for the Deciding Officer to make a decision should go in the NEPA document. For projects or activities which may affect air quality, enough analysis and discussion must be a part of the record to permit the responsible official to "find" the action in compliance with applicable air quality laws and regulations.

Direct Effects: Address the effects of emissions/smoke on air quality in the vicinity of the burn. How will concentrations of pollutants change, and how may these changes affect visibility, safety, and/or human health?

Indirect Effects: Include the effects of the dispered emissions/smoke on air quality downwind. Focus on effects to smoke sensitive areas that were identified in the Affected Environment section. Any projected wildfire vs. prescribed fire emissions trade-offs could be discussed under Indirect Effects.

Cumulative Effects: Address the effects of the smoke from the project combined with other pollution sources in the area. This may include effects close to or some distance downwind from the burn. Include results from any regional air modeling studies that consider wildland fire emissions increases in the area.

Specifically, the following steps are ideal for a complete smoke analysis:

1. Quantify applicable emissions and explain their importance. Typically the most important pollutant emitted by fire is fine particulate matter, or PM2.5. Other pollutants, such as carbon monoxide, nitrogen oxides (NOx), and VOC's need to be estimated if the project area is in a non-attainment area for CO or ozone (see Attachment 2 for more information). A simple inventory of emissions is a basic air quality assessment tool. All things being equal, less emissions are more desirable.

2. Mix and match burn areas and estimate maximum emissions that could be produced on a single day. Consider the potential of other owners burning in the same airshed at the same time. Calculate a range of possible daily and annual emissions.

3. Ideally, dispersion model analysis would be applied to all units burned including an analysis of maximum emissions situations, and to units burned under various atmospheric conditions. Downwind concentrations of PM2.5 and PM10 can then be compared to NAAQS. Visibility impacts can also be estimated.

   If dispersion modeling is undertaken:

- Determine if violation of NAAQS is a potential problem. Is visibility impairment a potential problem?
- If violation of NAAQS or visibility impairment is a potential problem, determine extra mitigation techniques that can be employed and repeat the analysis. Consider burning fewer units at a time. Describe atmospheric dispersion and mixing characteristics that must be used to avoid impacts.

If a suitable dispersion model is not available, describe qualitative impacts based on prevailing winds, local knowledge of typical smoke dispersion and who or what may be impacted under specific meteorological or burn conditions.

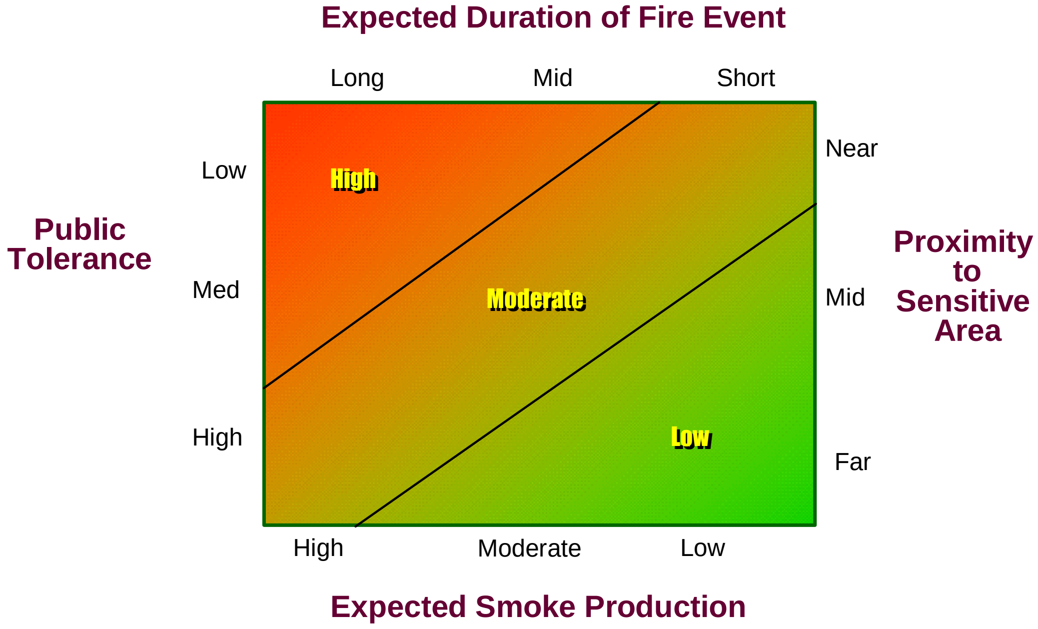
4. Review the applicable smoke management plan(s) and state visibility SIP's. Smoke Management Plan requirements are pertinent if there are existing controls on burning to minimize air quality impacts. Describe the effectiveness of the state smoke management program--how many intrusions occur in an average year? Is the burning associated with this NEPA project comparable to past year's burning which would enhance a reader's confidence that impacts will be comparable or less? If not, you may need to discuss how new or different mitigations associated with the Smoke Management Plan will be implemented. This is a useful component of the Cumulative Effects discussion.

Summary

Projects that involve the use of fire have the potential to impact public air quality. Smoke from fires can impact human health, impair scenic vistas, create safety hazards, and/or cause a general nuisance. It is our responsibility to assess and disclose these impacts as part of NEPA, and to minimize any impacts to the extent possible.

This document is intended as a quick start guide for analyzing air quality impacts from prescribed burning as part of a NEPA analysis. For more detailed information contact your local or regional air resource specialist or search the national NEPA web page at (URL to be determined).

Attachment 1
Air Quality Relative Risk Rating - Prescribed Fire



Q: What is the approximate risk that smoke from prescribed burning will cause an air quality impact?

Expected Duration of Prescribed Fire Event
- Short: less than 8 hours
- Mid : 8 - 12 hours
- Long: greater than 12 hours

Expected Smoke Production
- Low: small broadcast unit of less than 25 acres (or piles only), light fuel loadings, high burning intensity expected, meteorology likely to promote good dispersion.
- Moderate: 25 – 100 acres, heavier fuel loadings, meteorology somewhat stable.
- High: greater than 100 acres, heavy fuel loadings, area prone to poor dispersion.

Public tolerance
- Low: smoke impacts have been a problem in the past as evidenced by public complaints and/or negative press, burning will be in or near a non-attainment area.
- Medium: smoke impacts have not have generated many complaints in the past although the local public may not in general support agency activites or have much knowledge about the fire program. A few individuals may have registered complaints.
- High: air quality is not an issue to the local public. There is awareness and support for the use of fire.

Proximity to a sensitive area (for example a non-attainment area, population center, hospital, etc.)
- Far: greater than 60 miles
- Mid: 10 – 60 miles
- Near: less than 10 miles

ATTACHMENT 2
AIR QUALITY RULES OVERVIEW

Air pollution can be defined as the presence in the atmosphere of a substance or substances added directly or indirectly by a human act, in such amounts as to adversely affect humans, animals, vegetation, or materials. Air pollutants are classified into two categories: primary and secondary. **Primary pollutants** are those directly emitted into the air. Under certain conditions, primary pollutants can undergo chemical reactions within the atmosphere and produce new substances known as **secondary pollutants**.

The federal **Clean Air Act** is a legal mandate designed to protect human health and welfare from air pollution. States develop programs for implementing the Clean Air Act through their **State Implementation Plans (SIP's)**. States may develop programs that are more restrictive than the Clean Air Act but never less. Be sure to know specifics of your state air programs before completing an air quality analysis.

National Ambient Air Quality Standards (NAAQS) are defined in the Clean Air Act as levels of pollutant above which detrimental effects on human health or welfare may result. NAAQS have been established for the following air pollutants: particulate matter (PM10 and PM2.5[1]), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone, carbon monoxide and lead (Table 1). Primary NAAQS were established to protect human health; secondary NAAQS are designed to protect human welfare. The standards are expressed in different averaging times, for example, annual, 24-hour, and 3-hour. An area that is found to be in violation of a NAAQS is called a **non-attainment area**. Pollution sources contributing to non-attainment areas are subject to tighter restrictions. If a proposed federal project were projected to contribute a significant amount of pollution to a non-attainment area the project may need to be canceled or severely modified. State air quality agencies can provide up-to-date locations of local non-attainment areas.

The **conformity** provisions of the Clean Air Act prohibit federal agencies from taking any action that causes or contributes to a new violation of a NAAQS. Estimation of whether a federal project could cause a NAAQS violation may require use of sophisticated modeling techniques to estimate emissions produced at the source and concentrations of pollutant at important downwind locations. Even if the individual project is not expected to violate NAAQS, it must also be proven that the project will not contribute to the frequency or severity of an existing violation or delay the timely attainment of a standard.

Particulate matter emissions are produced from common Forest Service activities such as prescribed fire, road construction, road use, and mining. Carbon monoxide, nitrous oxides (NO_x), and volatile organic compounds (VOC's) are produced from prescribed fire, and vehicle and machinery operation. NO_x and VOC's can react with sunlight to form the secondary pollutant ozone.

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[1] PM10 is being phased out as a regulated pollutant.

Table 1: National Ambient Air Quality Standards (check with your state air regulatory agency for local standards).

POLLUTANT		NATIONAL PRIMARY	NATIONAL SECONDARY
PM2.5			
	Annual Average	15µg/m^3	15µg/m^3
	24-hour Average	35µg/m^3	35µg/m^3
PM10			
	Annual	NA	NA
	24-hour	150 µg/m^3	150 µg/m^3
Sulfur Dioxide (SO_2)			
	Annual Average	0.03 ppm	NA
	24-hour Average	0.14 ppm	NA
	3-hour Average	NA	0.50 ppm
Carbon Monoxide (CO)			
	8-hour Average	9 ppm	None
	1-hour Average	35 ppm	None
Ozone (O_3)			
	8-hour Average	0.075 ppm	0.075 ppm
Nitrogen Dioxide (NO_2)			
	Annual Average	0.053 ppm	0.053 ppm
Lead (Pb)			
	Quarterly average	1.5 µg/m^3	1.5 µg/m^3

Another provision of the Clean Air Act that sometimes affects Forest Service activities is the **Prevention of Significant Deterioration** provisions or PSD. The premise behind the PSD provisions is to prevent areas that currently have very clean air from being polluted up to the maximum point established by the NAAQS. Three air quality classes were established in the Clean Air Act, Class I, Class II, and Class III. **Class I areas** are subject to the tightest restrictions on how much additional pollution (called an **increment**) can be added to the air. Forest Service wilderness areas over 5000 acres and in existence as of August 7, 1977, and later expansions to these areas are Class I. Other Class I areas include National parks exceeding 6000 acres, national memorial parks exceeding 5000 acres, and international parks. A few tribes have redesignated their lands to Class I. No place in the country has ever been designated Class III so all other lands, from non-Class I wildernesses to urban areas, are Class II. PSD provisions are relatively easy to apply to point sources of pollution (power plants for example) but can be much more difficult for area sources (prescribed fire, mining, road use). Most Forest Service projects are area sources. States don't typically apply PSD provisions to intermittant area sources like prescribed burning. It may be necessary to discuss the implications of PSD with an air quality specialist or a state air regulatory specialist for specific projects.

The Clean Air Act also states a national goal of "the prevention of any future, and the remedying of any existing, impairment of **visibility** in mandatory Class I Federal areas which impairment results from manmade air pollution". Particulates are especially efficient at impairing visibility because of the way they scatter and absorb light.

Air quality regulations allow omission of certain pollution sources in air quality impact analyses if they are considered very minor and are certain to have no detrimental effects. These sources are considered to emit pollutant amounts below **de minimis** levels. For example, operation of a chain saw causes a small amount of air pollution but if this were the only source of pollution from a project an air quality analysis would not need be necessary. Air pollution sources that pass the de minimis test do not need to be included in air pollution impact analyses. De minimis levels have been defined for many industrial sources but little guidance is available for most Forest Service activities.

Key Regulated Pollutants and their Significance in Smoke

Fine Particulates (PM2.5)

Particulate is a term used to describe dispersed airborne solid and liquid particles which will remain in atmospheric suspension from a few seconds to several months. Particulates that remain suspended in the atmosphere are efficient light scatterers and therefore contribute to visibility impairment. Very small particles can travel great distances and contribute to regional haze problems. Regional haze can result from prescribed burning over multiple days and/or multiple owners utilizing the airshed over too short a period of time. Cumulative particulate load may be the result of prescribed burning only, or urban and industrial sources only, or it may be a combination of the two. The causes of regional haze are often difficult to identify. Total suspended particulates (TSP) include all suspended particulates, no matter the size. Particulate matter less than 2.5 microns in diameter (PM2.5), or less than 10 microns in diameter (PM10) describes particles small enough to enter the human respiratory system. Fires emit large amounts of fine particulate matter that can impact human health and impair visibility.

Particulate matter, alone or in combination with other pollutants, can constitute a health hazard. Particulates enter the body mainly via the respiratory system. Particulate matter may exert a toxic effect in one or more of the following ways:

1. The particle may be intrinsically toxic because of its chemical and/or physical characteristics.

2. The particle may interfere with one or more of the mechanisms which normally clear the respiratory tract.

3. The particle may act as a carrier of an absorbed toxic substance.

Medical studies have shown a solid relationship between increases in particulate concentrations and rises in the number of clinic and hospital visits for upper respiratory infections, cardiac diseases, bronchitis, asthma, pneumonia, and emphysema. Deaths of elderly persons afflicted with respiratory diseases and cardiac conditions also show an increase during periods when the concentration of particulate matter is unusually high for several days.

Some recent studies have indicated that urban particulate matter may be more dangerous to human health than rural particulate. There is speculation that urban pollution sources, like auto exhaust and industrial sources, may be more toxic than rural sources, such as dust or wood smoke. This theory has not yet been proven definitively.

There are few studies which evaluate the toxicity of forest fire smoke. Almost all investigations of the toxicity of smoke particulate matter in human populations have been conducted with particulates associated with burning coal or fossil fuels where sulfur oxides and sulfates are the important constituents. However, these chemicals are not generated in a significant quantity by vegetation fires.

Sulfur Dioxide

Sulfur dioxide (SO_2) is emitted primarily from combustion of fuel containing sulfur; generally either coal or oil. Sulfur compounds are also emitted naturally by marine sources, soils and vegetation, volcanoes, and geothermal activity. Humans respond to sulfur dioxide exposure with an increase in airway resistance. Most individuals show a response to SO_2 at concentrations of 5 ppm (parts per million) and above and certain sensitive individuals show slight effects at 1 to 2 ppm. Excess SO_2 in the atmosphere also effects sensitive vegetation.

Sulfur dioxide can also contribute to reduction in visibility. Atmospheric haze is caused by the formation of various aerosols resulting from the photochemical reactions between SO_2, particulate matter, oxides of nitrogen, and hydrocarbons in the atmosphere. Sulfur dioxide transforms into an acid when absorbed in cloud water and raindrops and can fall as acid rain.

Most forest fuels contain less than 0.2 percent sulfur so sulfur oxides could be produced only in negligible quantities during prescribed fires and wildfires.

Carbon Monoxide

Carbon monoxide (CO) is produced by automobile exhaust and other incomplete combustion sources. Carbon monoxide is a poisonous inhalant that deprives the body tissues of necessary oxygen. Extreme exposure (>750 ppm) can cause death. Impaired time-interval discrimination can occur when humans are exposed to concentrations as low as 10 to 15 ppm for 8 hours. Carbon monoxide exposure can also result in central nervous system effects such as impairment of visual acuity, brightness discrimination, and psychomotor functions. Symptoms include headache, fatigue, and drowsiness.

Large quantities of carbon monoxide are emitted from wildfire and prescribed fires. Carbon monoxide exposure from these sources can be significant for fireline workers but CO dilutes very rapidly in the atmosphere and probably is not a concern to urban and rural areas even a short distance downwind. One study measured CO concentrations as high as 200 ppm close to flames but observed that the concentration was reduced to less than 10 ppm just 100 feet from the fire.

Ozone

Ozone is a secondary pollutant formed from the reaction of volatile organic compounds with oxides of nitrogen in the presence of sunlight. Volatile organic compounds originate from industrial processes, solvent use, and transportation. The origin of nitrogen oxides is discussed in another section. Ozone can cause eye, nose, and throat irritation, and chest constriction in humans at concentrations above 0.10 ppm.

On vegetation, ozone can cause visible injury, reduced photosynthetic capacity, increased respiration, premature leaf senescence, and reduced growth. Other effects include alteration of carbon allocation, greater susceptibility to environmental stress, changes in plant community composition, and loss of sensitive genotypes from a population.

Prescribed fires and wildfires emit volatile organic compounds (VOC's) which can react with urban sources of nitrogen to form ozone. Elevated ozone levels have been measured at the top of smoke plumes. Elevated ozone in cities far downwind from wildfires have been attributed in part to wildfire smoke emissions. Ozone may be considered an issue with prescribed fire in the eastern parts of the US. It is generally not a concern related to smoke from western burning.

Nitrogen Dioxide

Oxides of nitrogen are formed in a combustion process when nitrogen in the air or in fuel combines with oxygen at elevated temperatures. Nitrogen dioxide acts as an acute irritant. Some increase in bronchitis in children has been observed at concentrations below 0.01 ppm. In combination with hydrocarbons, oxides of nitrogen react in the presence of sunlight to form photochemical smog or ozone. Nitrogen dioxide absorbs visible light and at a concentration of 0.25 ppm will cause appreciable reduction in visibility.

Formation of oxides of nitrogen occur at temperatures not normally found in prescribed fires. Some oxides of nitrogen may be formed at lower temperatures in the presence of free radicals, and nitrogenous compounds in forest fuels are another possible source. Generally, wildland fire is considered an insignificant contributor of these emissions.

Lead

The principal source of lead emissions is the combustion of gasoline containing lead alkyl additives. Since use of leaded gasoline has decreased dramatically, lead air pollution is rarely a problem anymore.

Lead particles that have been deposited on vegetation over decades can become re-emitted if the vegetation is burned. This phenomenon was documented during chaparral burning which took place east of the Los Angeles basin.